

News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 416, Room 119, Gaithersburg, MD 20899-0001; telephone: 301/975-3572.

NEW STATE OF MATTER SEEN NEAR ABSOLUTE ZERO

Researchers at JILA, a joint program of NIST and the University of Colorado at Boulder, recently announced that they achieved a temperature far lower than any previously produced and created an entirely new state of matter predicted 70 years ago by Albert Einstein and Indian physicist Satyendra Nath Bose. A paper in the July 14 *Science* by the researchers describe how the team cooled rubidium atoms to less than 170 nK above absolute zero. The extreme cold caused the individual atoms to condense into a “superatom” that behaved as a single entity. Before photographing the superatom—known as a Bose-Einstein condensate—the physicists cooled the atoms to 20 nK above absolute zero, the lowest temperature ever achieved. The achievement climaxed a 15 year search by physicists worldwide for the condensate.

PUBLICATION DETAILS METHODS FOR MEASURING VITAMINS

At the forefront of cancer research are numerous studies on the role of vitamins and beta-carotene in reducing the risk of cancer. Because so many laboratories worldwide are participating in these studies, quality control for analytical methods and measurements is very important. The precision and accuracy of data from each lab must be evaluated in order to make meaningful comparisons of data from different parts of the world. To help cancer research laboratories analyze vitamins accurately, the National Cancer Institute turned to NIST. In 1984, NCI and NIST began the Micronutrients

Measurement Quality Assurance Program. A new publication, *Methods for Analysis of Cancer Chemopreventive Agents in Human Serum* (NIST Special Publication 874), describes the two main components of the program: methods development and validation, and interlaboratory quality assurance through use of proficiency testing. SP 874 is available for \$27 prepaid from the National Technical Information Service, Springfield, VA 22161, (703) 487-4650. Order by PB 95-200648.

PROJECTS PROVIDE ENVIRONMENTAL TECH INFO

NIST recently announced two projects to help America’s smaller manufacturers use more efficient technologies and better management techniques to reduce or eliminate sources of pollution in their operations. One project establishes the National Metal Finishing Resource Center to provide companies with electronic access to comprehensive information on regulatory compliance and pollution prevention opportunities, technologies, and techniques. NIST, the U.S. Environmental Protection Agency, and four industry groups are funding the center. In a related project, the Massachusetts Manufacturing Partnership will integrate environmentally focused assistance into the broader services it offers smaller manufacturers. NIST, EPA, and several Massachusetts organizations are providing funding. Both projects are part of a larger effort being coordinated by NIST, in cooperation with EPA, to make environmental assistance readily available to smaller manufacturers. For more information, contact the MEP at (301) 975-5020 or mepinfo@micf.nist.gov (via Internet).

NEW GUIDE SIMPLIFIES INTERNATIONAL SYSTEM OF UNITS

It’s all you ever wanted to know about the metric system. NIST’s new *Guide for the Use of the International System of Units (SI)*, NIST Special Publication 811,

offers advice on proper use of the modern metric system. In the 1995 edition, a NIST physicist covers definitions of SI base units, rules and style conventions for expressing measurement results, conversion factors and proper use of units within and outside the International System of Units. Also included is NIST policy on the use of SI units in NIST publications, classes of SI units, SI derived units with special names, symbols and prefixes, and a checklist for reviewing manuscripts. Single copies of the 84-page guide may be obtained from the Calibration Program, A104 Building 411, NIST, Gaithersburg, MD 20899-0001, (301) 975-2002, fax: (301) 926-2884.

ENERGY-RELATED INVENTIONS PROGRAM RECOMMENDATIONS

The NIST Office of Technology Evaluation and Assessment recommended four innovative technologies for commercialization to DOE under the Energy-Related Inventions Program during April and May. These were:

- (1) 4000 °F Radiant Burner Screen Material “a new material that could make possible production of commercial grade industrial radiant burners with sustained service temperatures of about 4000 °F.
- (2) Process to Recover Acid and Metal Salts from Pickling Liquors—a process for recycling the waste pickling liquor from sulfuric acid-based pickling baths.
- (3) Steam Generator Feedwater Control System “an instrument designed to improve the reliability and safety of pressurized water nuclear power plants by more accurately measuring the mass of water in the steam generator, significantly avoiding boiling instabilities and reducing the probability of tripping reactor operational switches during start up and low power operation.
- (4) Electronic Starter Device for Fluorescent Lamps “an electronic starting device that acts as a substitute for a glow switch used for compact fluorescent lamps.

NIST SCIENTIST NAMED CONVENER FOR NEW IEC WORKING GROUP ON LOW-FREQUENCY MAGNETIC AND ELECTRIC FIELD MEASUREMENT

A NIST scientist has been named the convener of a newly created working group of the International Electrotechnical Commission (IEC) Technical Committee 85. The task of this group, designated IEC TC 85/Working Group 11, is to draft a standard providing

guidance for measuring magnetic and electric fields in the range 15 Hz to 10 kHz.

The preparation of an IEC measurement standard was prompted by the recent publication of the European Prestandard, ENV 50166-1, “Human exposure to electromagnetic fields, Low-frequency (0 Hz to 10 kHz).” The European prestandard sets restrictions on human exposure to magnetic and electric fields in the frequency range 0 Hz to 10 kHz and is intended for “provisional application” for 3 years. The Working Group 11 draft document, Definitions and Methods of Measurement of Low Frequency Magnetic and Electric Fields with Particular Regard to Exposure of Human Beings will include descriptions of the instrumentation, terminology, requisite field meter specifications, calibration methods, and sources of measurement uncertainty. The first draft was prepared at NIST and circulated to members of the working group earlier this year. A major portion of the text is taken from a recently approved IEEE Standard 1308, Recommended Practice for Instrumentation: Specifications for Magnetic Flux Density and Electric Field Strength Meters—10 Hz to 3 kHz, the draft of which also was prepared at NIST.

ON-WAFER CALIBRATION METHOD COMPENSATES FOR SUBSTRATE PERMITTIVITY

Two NIST scientists have developed a coplanar waveguide scattering parameter calibration procedure for on-wafer testing of monolithic microwave integrated circuits (MMICs). This procedure accounts for measurement errors due to differences in the permittivities of the calibration and measurement substrates. These errors are often as large as 20 % in practical circumstances. Microwave measurements for MMICs usually require custom calibration sets with the same probe and launch used to contact the devices or circuits under test in order to accurately account for their effects. In the past, this has meant that all of the calibration artifacts had to be manufactured on the same wafer as the structures to be tested. Putting calibration artifacts on expensive test wafers consumes precious area that otherwise might be devoted to working circuits.

An alternate approach is to fabricate the calibration artifacts on a separate wafer. The scientists have made this approach feasible through their development of a simple model that accounts for the errors introduced into the calibrations by a change of substrate. The calibration method incorporates this model, which is based on an easily calculable or measurable capacitance at the tip of the probe used in the measurements, to correct for the substrate errors. This extends the applicability of the calibration beyond the substrate on which it is performed. The result frees significant area on the test

wafer and also suggests methods for achieving traceability to national standards despite the significant and often unavoidable differences in the electrical properties of the calibration and measurement substrates. The method requires that the devices and circuits to be tested are embedded in a standard coplanar geometry.

HIGH-TEMPERATURE SUPERCONDUCTING MILLIMETER-WAVE OSCILLATOR DEMONSTRATED

NIST scientists have fabricated and demonstrated one of the most complex high-temperature superconducting (HTS) circuits to be designed so far: a proof-of-principle high-frequency oscillator with an on-chip integrated detector. Such a device could ultimately act as the local oscillator in receivers operating in the millimeter-wave to far-infrared (terahertz frequency) region, for which tunable frequency sources have not been readily available but are needed for applications such as observation of Earth atmospheric gasses and advanced wireless communications.

The complexity of the new circuit represents progress toward other HTS applications, such as voltage standards that can be operated with closed-cycle refrigeration. The oscillator is based on a novel circuit concept developed by a guest worker from the German research institute KFA-Juelich. It relies on a well-known property of Josephson junctions, the conversion of a dc bias voltage to an oscillating current with a frequency related to the voltage by the factor 0.484 THz/mV. The difficulty in realizing a useful circuit in HTS materials stems from the lack of uniformity achievable in present HTS Josephson junctions. The new design overcomes this problem by embedding the HTS junctions in coplanar microwave resonators to assist in phase-locking the junction array. Fabrication of the array oscillator required integration of HTS junctions, transmission lines, filters, and capacitors, using five thin-film levels of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$, gold (twice), silicon monoxide, and strontium titanate. To demonstrate successful operation at high frequencies, the circuit incorporated an on-chip HTS detector junction coupled to the array through an integrated dc-blocking capacitor. Power was detected from 60 GHz to 250 GHz with a maximum of over 1 nW at 160 GHz. This experiment provides a basis for designing larger arrays of higher-frequency junctions, having sufficient power and narrow enough linewidths to be useful as local oscillators at terahertz frequencies.

REPORT CONSIDERS EFFECTS OF POLARIZATION UNCERTAINTY ON RCS MEASUREMENTS

In response to needs of the radar cross-section (RCS) community, NIST scientists have completed a study showing how RCS measurements are complicated by the contribution of polarization uncertainty to overall measurement error, especially for depolarizing targets. NIST scientists report the results of their study in *Polarimetric Calibration of Reciprocal Antenna Radars* (NISTIR 5033). Initial discussion in this report centers on the adverse effects of target depolarization on cross-polarization contamination, and the authors present graphical examples of polarization error in the measurement of the RCS of an inclined dihedral reflector. Error correction requires complete polarimetric RCS measurements. The authors describe a simplified polarimetric calibration method they developed that is applicable to reciprocal-antenna radars. This method uses a dihedral calibration target mounted on a rotator. Because the calibration standard is rotated, there is no need to mount and align multiple separate standards, as required by other methods. Also, clutter and noise can be rejected by averaging over rotation angle. These advantages constitute a significant improvement over other calibration methods now in use.

NIST PROVIDES MEASUREMENT SUPPORT NEEDED BY SATELLITE COMMUNICATIONS INDUSTRY

NIST has just completed a 6-month project for a private company in support of the satellite communications industry. The company is helping to provide an antenna near-field scanning range and probes to be used with the Globalstar and Tempo low-earth-orbiting communication satellite programs currently in progress. NIST's antenna laboratory calibrated four dual-port circularly polarized probes for the company to be used as standards. These probes cover four different frequency bands ranging from 1.6 GHz to 17.5 GHz; NIST staff measured gain, polarization, and pattern, using the new multipurpose antenna range. The low-frequency probes (1.6 GHz) were approximately 2 m long and had a mass of about 30 kg. These are the largest probes that have been calibrated so far on the new NIST range. The high-frequency probes (17.5 GHz) were 20 cm to 30 cm in length and had a mass of 1 kg to 2 kg.

NIST HELPS DEFINE ELECTRICAL MEASUREMENTS NEEDED FOR INTERNATIONAL TRADE

At its June meeting at the International Bureau of Weights and Measures in Sèvres, France, the Consultative Committee on Electricity adopted a set of international comparisons of electrical measurements that, when completed, could ease impediments to international trade. U.S. interests were represented by staff from NIST. The International Bureau of Weights and Measures is a treaty organization funded by industrialized countries to maintain worldwide uniformity in measurements. The Consultative Committee on Electricity, which helps to set the technical program in the electrical area, is made up of representatives from the national measurement laboratories of the member countries. Regional activities in Europe, North America, and the Asian Pacific region had a significant impact on the committee's deliberations and conclusions.

Quality assurance systems used by manufacturers worldwide require that measurements be consistent with national standards. In the electrical area, advances in fields such as computing and telecommunications are requiring national measurement laboratories to support an ever-widening range of very accurate electrical measurements. The broader need for accuracy is outstripping the methods currently in place to assure that national measurement systems in the various countries are consistent.

The approach adopted by the committee emphasizes the comparison of selected key measurements beyond the historical focus of international comparisons on basic standards. In the past, determinations of the basic standards could be much more accurate than "practical" measurements. So if a laboratory could maintain a basic standard, it was likely it also could support more practical measurements. Today, however, practical measurements require high accuracy. Thus, in addition to the comparison of basic standards, the committee recommends comparison pertaining to: (1) verification of voltage and impedance scaling from the basic standards in support of the electronic instrumentation industry; (2) ac-dc difference measurements needed to relate the measurement of time-varying signals to the time-invariant standards; (3) measurement of electric power to support equity in revenue metering; and (4) measurement of microwave power and noise to support advances in wireless and optical telecommunications systems.

NIST LEADING EFFORT TO UNIFY ROCKWELL HARDNESS STANDARDS

Immediately prior to the recent meeting of the ISO Subcommittee on Hardness Testing (ISO/TC164/SC3),

a special technical round-table discussion was held to determine the need for defining a single International Hardness Reference Standard Scale. At present, different Hardness Reference Standard Scales are defined in Europe, Japan, and the United States. These "performance-based" scales have disadvantages because they are based only on comparisons of their own hardness testing. Agreement was reached at the meeting to establish a "Metrology-Based Standard System" to unify international Rockwell hardness standards. According to this approach, the "properly defined" scale is established through fundamental metrology. The metrology-based Rockwell hardness reference standards are to be measured with a high-accuracy microform calibration system, such as the one developed at NIST. Uncertainties are established through procedures also recently developed at NIST. A collaboration between the national laboratories was set up to study this approach.

Extensive testing of the microform and the hardness performance of several types of indenters was initiated during the meeting and carried out subsequently at NIST. These tests will establish the basis for the development of a worldwide hardness standard. A research paper entitled "A Metrology Approach to Unifying Rockwell Hardness Scales" by three NIST scientists was accepted by the International Hardness Conference held in Germany in November 1995.

NEW AXIS REPRESENTATION FOR GEOMETRIC FITTING

Researchers at NIST have developed a novel method for representing axes of geometric elements (cylinders, cones, tori, etc.). This representation has advantages in geometric fitting problems. Experiments have shown that it can reduce the estimated sensitivity of computed fit to numerical roundoff errors by 90 % or more over existing representations. A journal article describing the method is under review. The representation is being used in the recently approved Algorithm Testing and Evaluation Program for Coordinate Measurement Systems (ATEP-CMS) Special Test Service.

INTERNATIONAL COMPARISON OF TEMPERATURE STANDARDS AT NIST

Intercomparisons of triple point of water (TPW) cells between NIST, the Centro Nacional de Metrologia (CENAM) of Mexico, the National Institute of Metrology (NIM) of China, and the National Metrology Institute (UME) of Turkey were performed recently at NIST. Agreement in the realization of the TPW among the cells within a national laboratory as well as with the cells of other national laboratories is a critical aspect of

the continuing effort to assure the accurate realization of the International Temperature Scale of 1990 (ITS-90).

The triple-point temperature of water is assigned the value 273.16 K on the thermodynamic temperature scale and also on ITS-90. It is the reference temperature for resistance ratios in platinum resistance thermometry. Each intercomparison of TPW cells was performed using a standard platinum resistance thermometer to measure the difference between the triple-point temperatures of the two cells as they were compared directly with one another over a 2-week period. The results of the intercomparisons indicate that the triple-point temperature of the cells from CENAM, NIM, and NIST have no discernible difference to within an expanded uncertainty of 0.02 mK. The triple-point temperature of the cell from UME was 0.04 mK lower than that of the NIST cell, indicating a higher level of impurity in the water contained in the cell. However, this level of agreement is within the uncertainty expected in the overall realization of the ITS-90.

ISOTOPE EFFECTS DISCOVERED IN THE FORMATION OF COMBUSTION AEROSOL WITH IMPLICATIONS FOR CLIMATE CHANGE

Cooperative research has demonstrated for the first time carbon isotope fractionation in soot formation during combustion having a possible link with patterns of co-produced polycyclic aromatic hydrocarbons (PAHs). This work was directed toward the investigation of carbonaceous aerosols and their potential effects on climate change. The research was performed by scientists from NIST and the U.S. Geological Survey.

Key findings of the research that have special relevance to the investigation of atmospheric aerosols from biomass burning and anthropogenic combustion were that significant ^{13}C isotopic fractionation occurs in the transformation from carbonaceous fuel to “soot” and that an apparent relationship exists between ^{13}C isotopic fractionation and PAH molecular patterns resulting from incomplete combustion. Crucial to the success of the studies was the ability to measure ^{13}C abundances to a precision that was at least six times better than previous capabilities and the use of cryohomogenization at the NIST Environmental Specimen Bank to prepare isotopically homogeneous biomass fuel samples.

In addition to the theoretical importance of isotopic and molecular fractionation in the combustion process, the results of the research have practical implications for long-range tracking of carbonaceous aerosols. Since isotopic measurements are used in identifying sources of combustion, isotopic fractionation has to be taken into account for quantifying anthropogenic and natural impacts on regional and global aerosol. The results were presented at the Symposium on Clouds, Aerosols, and

Radiation at the recent meeting of the American Geophysical Union in Baltimore, MD.

NIST HOSTS FORUM ON CLINICAL INSTRUMENT-TO-CLIMS COMMUNICATION

NIST sponsored a meeting recently to discuss standards for interfacing, messaging, and test/result naming for use with clinical laboratory instruments and clinical laboratory information management systems (CLIMS). ASTM, the National Committee for Clinical Laboratory Standards, and the American Association for Clinical Chemistry co-sponsored the meeting, which was attended by more than 40 U.S. and foreign representatives of clinical instrument manufacturers, diagnostic equipment manufacturers, clinical laboratories, and the host organizations.

The purpose of the forum was to lay foundations for a coordinated standards development effort in clinical laboratory automation. Committee members and officers from the major clinical standards and industry groups presented their organization's current activities and plans. The usage and shortcomings of existing clinical automation standards were discussed to identify needs for future developments, including a need for the conformance testing of commercial instrument messaging software to existing consensus standards. Current efforts to develop standard names and codes for clinical tests and results were described. Realization of standard names and codes for laboratory tests and results is essential to the further development of healthcare informatics and to any electronic patient record scheme. Issues relating to the development, marketing, and maintenance of such standardized names were examined.

WORKSHOP ON RADIONUCLIDE SPECIATION IN SOILS AND SEDIMENTS

Potentially, billions of dollars of remediation costs could be saved and social concerns could be addressed with reliable and interpretable information on the chemical forms (speciation) of the nuclides and their distribution in the environment. NIST is laying plans to develop a new series of environmental Standard Reference Materials (SRMs) for radionuclide speciation. As a first step toward this goal, NIST recently co-sponsored a radionuclide speciation workshop with the Council on Ionizing Radiation Measurements and Standards. The objective of the workshop was to develop a consensus on the extraction protocol for the certification of a new series of radio-active soil and sediment SRMs. The future environmental radionuclide SRMs for radio-plutonium, uranium, thorium, strontium, and cesium will be used by those making decisions for risk assess-

ment, selection of cost-effective mitigation strategies and technologies, and developing and executing long-term monitoring.

Representatives from industry, academia, and government attended the workshop. At the workshop's conclusion, a general approach for the leaching procedure was adopted. The critical variables affecting the execution of the procedure were identified, and a statistical experiment was designed for evaluation and optimization. A network of collaborations was developed for future round-robin testing of the protocol and for certifying future SRMs by interlaboratory comparisons.

IN SITU SCANNING TUNNELING MICROSCOPY STUDIES OF THE ELECTRODE-ELECTROLYTE INTERFACE

In situ scanning tunneling microscopy (STM) is being used to investigate a variety of technologically relevant phenomena (e.g., electrodeposition, corrosion, and etching), which occur at electrode-electrolyte interfaces. The microscope is capable of imaging surface structures and associated dynamics over a scale ranging from the atomic to the micrometer level. A bipotentiostat enables independent electrochemical control of the tunneling probe and structure.

Currently, several generic issues concerning the electrodeposition of transition metals such as nickel and copper are being examined. The commercial success of the electroplating industry stems largely from the remarkable influence of electrolyte additives on the physical properties of the deposited film. Since the chloride ion is a ubiquitous species in most commercial processes, initial studies have been concerned with acid chloride electrolytes. STM reveals that the surface of the copper electrode is covered with a layer of chlorine at electrode potentials associated with copper deposition and dissolution. The resulting chlorine adlayer subsequently controls the step morphology of the evolving surface. When the chloride adlattice is reductively desorbed at negative potential consistent with the electrodeposition of nickel, the surface reorders toward a lower energy orientation. Similar experiments are under way to examine the complex role of other inorganic and organic additives in the microstructural evolution of electrodeposited metal films.

NIST DEVELOPS CRADA TO REDUCE WELD SPATTER

Under a cooperative research and development agreement (CRADA), a private company and NIST will combine the Institute's arc sensing and diagnostic techniques with the company's advanced welding equipment to determine the causes of spatter and fumes. With

the data gained, NIST researchers hope to design intelligent control systems for welding automation that will reduce weld spatter significantly. Ultimately, the company would like to market an automated welding system at the completion of their partnership with NIST. If successful, the project also may lead to further collaborations to reduce welding noise and fumes at higher deposition rates.

WORKSHOP ON INSTRUMENTED INDENTATION

An international workshop, jointly sponsored by NIST and the Institute for Mechanics and Materials (IMM), was held recently in San Diego, CA, to discuss the scientific and standardization issues associated with instrumented indentation. In this technique, a diamond probe is pushed into the surface of a material, and the load on, and displacement of, the tip are recorded throughout the loading-unloading cycle. Analysis of the resulting load-displacement curves can, in principle, yield information on a wide range of material mechanical properties. Commercial machines are now available that permit the measurement of properties like hardness and elastic modulus from indentations 10 nm to 20 nm deep. However, there currently are neither standard reference materials nor standard data analysis procedures to permit interlaboratory comparison of results. This lack of standardization has hampered the acceptance of instrumented indentation data by design engineers, who increasingly need mechanical property information on thin films and nanoscale structures. At the workshop, over 90 representatives from industry, academia, and national labs worldwide (including NIST, the National Physical Laboratory, U.K., and the Commonwealth Scientific and Industrial Research Organization, Australia) met to discuss the indentation process and the problems underlying the lack of standardization in the field. A report on the workshop will be available.

NIST WORKSHOP OUTLINES DIRECTION FOR RESEARCH ON DURABILITY OF ORTHOPAEDIC DEVICES

The need for better test methods to evaluate the wear performance of materials used in orthopaedic total hip and knee implants was the subject of a NIST-industry workshop held recently. The workshop objective was to develop a common research agenda with NIST and industry-wide participation that would lead to the development of accelerated screening-test methods. Currently, the screening and selection of materials are accomplished by expensive, time-consuming (3 month) tests on complex total joint simulators. Other methods,

such as pin-on-disk tests, are faster, but the results do not correlate with those from simulators or with clinical experience. More reliable test methods would facilitate the development of improved materials or processes and would find use in implant material quality assurance.

Eighteen representatives from industry participated in technical presentations and discussions along with representatives from university hospital research laboratories, the Food and Drug Administration, and NIST scientists. Participants devised a strategy for identifying test methods to satisfy the industry's needs and decided that a research plan should be pursued under a cooperative research and development agreement (CRADA). An industrial steering committee, comprised of one representative each from eight of the orthopaedic companies present, was formed. The steering committee met at NIST and outlined a research plan consisting of a technology survey, round-robin testing, data analysis, and investigation into new test methods. The committee also drafted a CRADA for NIST and the participating companies to review.

BACnet INTEROPERABILITY TESTING ACHIEVES PROMISING RESULTS

NIST has been working with industry and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for several years to develop a standard communication protocol for building control systems. This collaboration has resulted in a draft American National Standard known as BACnet (Building Automation and Control Networks).

To assist industry in developing interoperable products based on the BACnet standard, the NIST BACnet Interoperability Testing Consortium was formed. The objectives of the consortium are to: 1) assist control system manufacturers in verifying the correctness and interoperability of their proprietary BACnet implementations, 2) verify the technical soundness of the BACnet protocol, 3) identify errors or omissions in the BACnet protocol specification before it becomes a final standard, 4) identify ambiguities in the BACnet protocol specification that might lead to implementations that cannot interoperate, and 5) develop insight into testing requirements that should be included in a future ASHRAE standard for testing conformance to the BACnet protocol. The consortium currently has 15 members from industry, academia, and NIST.

Five of the consortium members have conducted a series of tests in NIST laboratories with very positive results. Errors in BACnet implementations have been found and corrected early in the product development

process. Errors in the protocol specification have been identified and corrected. Different interpretations of some protocol requirements have resulted in clarifying language being added to the standard. All parties involved have considered the results thus far to be a great success. Further testing of BACnet implementations with other consortium partners will continue throughout the year.

The consortium has made arrangements for a public demonstration of interoperable BACnet technology at the ASHRAE/ARI (Air-Conditioning and Refrigeration Institute) equipment show in February 1996 in Atlanta, GA. Approximately 10 companies will be involved in that demonstration.

ANALYSIS OF HIGH BAY HANGAR FACILITIES FOR DETECTOR SENSITIVITY AND PLACEMENT

High bay areas such as aircraft hangars, hotel atriums, and warehouses pose some of the most difficult fire challenges. Existing building and fire codes in the United States offer little or no guidance for the design of fire protection systems in high bay spaces due to the lack of scientific data. NIST, in conjunction with the Naval Facilities Engineering Command, has been conducting full-scale fire tests in high bay aircraft hangars. This project encompasses 35 full-scale experiments burning aviation fuels in two aircraft hangars (15 m and 22 m ceiling heights).

The purpose of this study was to analyze the movement of smoke and heat in high bay spaces to aid the Navy in reevaluating its design criteria for fire protection systems in those spaces. Fire sizes were varied from 100 kW to 47 MW, and wind conditions reflected both open and closed hangar doors. Concerns included: detector sensitivity to fire size; effect of temperature stratification and wind on detector performance; effects of draft curtains sprinkler activation; overall performance of heat, smoke, and projected beam detectors in high bay environments; and response thresholds of optical detectors to various fire sizes and fuel types. Detectors evaluated included infrared and ultraviolet radiation detectors, analog addressable smoke detectors, fixed temperature heat detectors, projected beam smoke detectors, and quick and standard response sprinkler heads in a variety of temperature ratings.

The tests were conducted in two locations: a cold climate and a warm climate. The purpose of conducting the tests in two distinctly different climates was to understand how smoke movement and detector sensitivity are impacted by ambient temperature.

NEW PUBLICATION DESCRIBES SELF-MONITORING ACCOUNTING SYSTEMS

NIST Special Publication 500-226, *Self-Monitoring Accounting Systems*, focuses on the need for more dependable accounting and financial systems in the Federal Government. It recommends a service for use by management in performing self-audits of financial systems and describes how the service can provide more internal control and financial information than usually obtained from analysis by financial consultants.

NORTH AMERICAN INTEGRATED SERVICES DIGITAL NETWORK (ISDN) USERS' FORUM (NIUF) MEETS

On June 7-9, 1995 NIST sponsored the 24th meeting of the NIUF, which was attended by about 130 ISDN users, implementors, and service providers. Tutorials focused on ISDN around the world, telecommuting, basic ISDN, and ISDN-SS7 interoperability. A private company hosted a National ISDN Ordering Codes (IOC) Seminar for industry participants to provide an overview of the IOC process, describe its benefits, and give implementation examples from industry. An update on the Global '95 Event scheduled for Nov. 28-30, 1995 was given. This international event will provide an opportunity for implementors to demonstrate global interoperability, present products and services in new markets, and enjoy global attention on ISDN solutions.

Highlights of the forum included the announcement that the Corporation for Open Systems (COS) is producing the second edition of the ISDN Solutions Guide and is seeking user success stories; the National Information Infrastructure (NII) Working Group discussed the many services and business applications that can be mapped directly to the NII; three major switch suppliers presented their current plans for the National ISDN platform; and the process for gathering and developing industry input to this effort was described. At the closing plenary session, two new documents were approved, including an addition to the NIUF Applications Catalog on Remote LAN Access; four documents approved by the Working Group will be voted upon at the next meeting. Three new charters were approved: Enterprise Communications Working Group (previously Private Industries); Mass Market Industries; and Private Switching Working Group (previously PBX Issues Subcommittee). The new NIUF Home Page can be reached on the WWW at: <http://www.niuf.nist.gov/misc/niuf.html>

NIST ISSUES EVALUATION GUIDELINES FOR X.500 DIRECTORY PRODUCTS

NIST Special Publication 500-228, *Guidelines for the Evaluation of X.500 Directory Products*, assists users in evaluating X.500 products and making informed choices as to which available products best match the requirements of their organizations. The X.500 Directory is a distributed database, capable of storing information about people and objects in various nodes or servers distributed across a network. These servers, acting in concert, potentially provide the global access to information made possible by X.500 technology. The document targets procurement officials, systems administrators, and others involved in the process of obtaining or recommending X.500 products for use in their organizations.

ELECTRONIC DATA INTERCHANGE (EDI) STANDARDS COMPARED

NISTIR 5631, *An Analysis of ANSI ASC X12 and UN/EDIFACT Electronic Data Interchange (EDI) Standards*, compares and contrasts two standards that specify sets of design rules and formats for EDI. The ANSI ASC X12 standards are American National Standards that are deployed widely in North America; the UN/EDIFACT standards are international standards that are used worldwide. Both sets of standards can be used extensively in a wide range of business applications, including healthcare, banking, customs declaration, order processing and purchasing, transportation, and education. The publication assesses the standards in terms of functionality, efficiency, and the existing level of standards development to determine which standard better satisfies current user needs.

SBus MULTIKRON INTERFACE BOARD SUBJECT OF NEW REPORT

NISTIR 5652, *Operating Principles of the SBus MultiKron Interface Board*, describes the SBus MultiKron Interface Board (SIB), part of the MultiKron Experimenter's Toolkit, which allows users to take advantage of the NIST MultiKron performance measurement chip in systems that do not already have a MultiKron designed into them. In addition to the SIB, the toolkit contains installation software, data logging software, and analysis software; all of the software supplied is written in C. The toolkit allows researchers to obtain hands-on experience with the MultiKron performance measurement chip, without the engineering effort required to design and build a hardware interface between the MultiKron and their computer.

DATABASE PUTS NEW SPIN ON REFRIGERATION CYCLES

A new NIST standard reference database, CYCLE_D, will help refrigeration and air conditioning engineers design equipment by simulating vapor compression refrigeration cycles. It incorporates data on the 38 pure refrigeration fluids and mixtures contained in NIST's widely used REFPROP standard reference database (SRD 23). REFPROP helps predict the efficiency and capacity of equipment that will use alternative, ozone-friendly refrigerant fluids in place of chlorofluorocarbons. The compressor can be represented by either compressor efficiency or compressor maps provided by the user. Along with inputting specific refrigerants and hardware components as required, the user also can include data on the parasitic power of the indoor fan, outdoor fan and control unit of the system being simulated. CYCLE_D requires an IBM-compatible personal computer with a hard disk containing 2 MB of available space and capable of running MS-Windows™ version 3.1 or higher. The database is available for \$390 from the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-2208, fax: (301) 926-0416, e-mail: srdata@enh.nist.gov (via Internet).

NIST, ANSI PACT STRENGTHENS U.S. STANDARDS SYSTEM

In an effort to support U.S. competitiveness, economic growth, health, safety, and protection of the environment, NIST and the American National Standards Institute signed a memorandum of understanding (MOU) to enhance and strengthen the national standards system. Both organizations have agreed on the value of a national approach to develop the best possible international standards. The MOU cites the need for more timely information flow within and between the private sector and the Federal Government, as well as the need for improved liaison to facilitate decision making and implementation of standards actions at both the national and international levels. Another point recognized within the MOU: the critical importance of giving U.S. regulatory agencies affected by voluntary standards the opportunity to contribute to the standards' development and implementation.

NEW SENSOR GETS CRACKIN' ON DETECTING FLAWS

NIST scientists have developed a wideband acoustic emission sensor for detecting cracks in steel bridges, pressure vessels and composite parts such as those used in automobiles and aircraft. Partly patterned after a

conical sensor developed at NIST in 1982, the new displacement sensor features a significant increase in sensitivity that rivals the level found in narrowband resonant sensors. The device operates in the frequency range from 30 kHz to 1.2 MHz, and has electromagnetic shielding and mechanical protection of sensitive elements. It functions nearly independently of frequency. But the future may bring forth even a better instrument. Under a cooperative research and development agreement, NIST and a private company hope to combine the best elements of the NIST sensor and a similar device developed by the private firm. Information on the NIST acoustic emission sensor and the partnership with the company can be found in a recently published paper, no. 19-95. For a copy, contact Sarabeth Harris, Div. 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, e-mail: sarabeth@micf.nist.gov (via Internet).

POLLUTANTS IN MARINE MAMMALS SUBJECT OF REPORT

A new NIST report contains updated environmental contaminant data from the Alaska Marine Mammal Tissue Archival Project, a collection of whale, seal, walrus, and sea lion tissues (usually blubber and liver) used for long-term monitoring of toxic substances to which these animals are exposed. The samples are archived in NIST's Biomonitoring Specimen Bank. A portion of the stored tissues are analyzed to determine levels of trace organic constituents, including chlorinated hydrocarbons and toxic elements. The collection now contains tissue specimens from 130 animals. AMMTAP is sponsored by the National Biological Survey and the National Oceanic and Atmospheric Administration. Copies of Concentrations of Chlorinated Hydrocarbons, Heavy Metals and Other Elements in Tissues Banked by AMMTAP (NISTIR 5620) are available for \$27 prepaid from the National Technical Information Service, Springfield, VA 22161, (703) 487-4650. Order by PB 95-2098870.

RESEARCHERS CRACK OPEN "GATE" TO FASTER COMPUTING

Computer scientists are always hoping for faster, more powerful computing machinery to tackle the most intractable problems. Recent theoretical papers have shown that quantum computers, exploiting the properties of quantum mechanics to provide parallel processing on a nearly unimaginable scale, would perform in seconds certain calculations that would take the lifetime of the universe on the fastest existing computers. Now, NIST researchers report (in a paper submitted to Physical Review Letters) that they have demonstrated

the essential first step toward such a computer: a universal quantum logic gate. The gate consists of a beryllium ion, cooled and trapped in an electromagnetic trap, that can be in one of two spin states and simultaneously in one of two vibratory states. When stimulated by a series of suitably tuned laser pulses, the ion will switch to one of four final spin/vibration states that depends on the initial state. Such gates are the fundamental building blocks of computing circuits. While the single gate demonstrated is not useful for actual computation, the technique appears to be applicable to a larger collection of laser-cooled ions, to build a quantum register. As the number (n) of ions increases, with each ion representing a quantum bit, the number of combinations increases as 2 to the n th power. The NIST researchers plan to continue their work in the direction of increasing the number of ions and studying how to couple the information stored on one ion to its neighbor. For more information, contact Chris Monroe, Div. 847.01, NIST, Boulder, CO 80303-3328, e-mail: monroe@boulder.nist.gov (via Internet).

G-7 PROJECT HELPS SMALLER BUSINESSES IN GLOBAL MARKET

Small and medium-sized enterprises in the United States are encouraged to participate in a pilot program sponsored by the G-7 countries (representing the world's seven largest Gross National Products) to identify the information needs of these businesses, promote their wider use of information networks, and foster increased cooperation and trade through electronic means. Among the areas for which the project serves as a resource are information services, multilingual and multicultural systems, financial systems management, ownership of property in "cyber-commerce," confidentiality, verification and technology interoperability. Businesses can highlight their participation in the G-7 project by including their URL on the G-7's Global Marketplace information server on the World Wide Web, as well as displaying the G-7 logo at the bottom of their business's home page. This logo should be incorporated as a "clickable icon" that will link browsers to the G-7 server. Coordinating the G-7 project is CommerceNet, a nonprofit, industry-led consortium of more than 140 U.S. companies and organizations promoting Internet-based electronic commerce. NIST collaborates with CommerceNet through a cooperative research and development agreement. For more information, contact Fran Nielsen, B217 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3669, fax: (301) 590-0932, e-mail: fnielsen@nist.gov (via Internet).

NIST HANDBOOK 150-11, ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS—FCC METHODS

The National Voluntary Laboratory Accreditation Program (NVLAP) has published NIST Handbook 150-11, Electromagnetic Compatibility and Telecommunications—FCC Methods for use by laboratories accredited by NVLAP. The handbook, which is fully ISO/IEC Guide 25 compatible, contains administrative and technical requirements for accreditation of laboratories that test computers and peripherals to Federal Communications Commission (FCC) requirements in 47 CFR Part 15 and telecommunications devices to 47 CFR Part 68. Standards from the Institute of Electrical and Electronics Engineers, the Telecommunications Industry Association, and the FCC are referenced. Negotiation of Mutual Recognition Agreements with the European Union and several individual nations should lead to acceptance of test reports from NVLAP accredited laboratories. A recent FCC Notice of Proposed Rulemaking (FCC ET Docket No. 95-19) proposed "to require that laboratories testing personal computers and personal computer peripherals be NVLAP accredited."

ACCOMPLISHMENTS OF U.S./SAUDI ARABIA STANDARDS COOPERATION PROGRAM

The U.S./Saudi Arabia Standards Cooperation Program recently completed its fifth successful year of operation. In response to a Congressional mandate, NIST established a Standards Assistance Program in 1990. With administrative assistance (and initial financial support) from the American/Saudi Roundtable (an association of U.S. companies with business interests in Saudi Arabia), the program has had substantial impact in the development of technologically advanced national standards, the development of testing and certification systems in Saudi Arabia, and has enhanced market access for U.S. manufacturers and exporters. NIST works with the Saudi Arabian Standards Organization (SASO), stationing a NIST standards adviser in Riyadh. More than 650 draft Saudi standards have been reviewed by U.S. technical experts from some 100 organizations, and more than 400 sets of comments have been coordinated with SASO. This Standards Assistance project has been highly successful, with dozens of "success stories" affirmed by the American Business Council of the Gulf Countries (widely regarded as the voice of U.S. business in that part of the world). Results include:

- thwarting a challenge from the Europeans to change the Kingdom's residential power system from 127 to 220 volts;

- adoption of performance criteria favorable to U.S. earthmoving equipment;
- repeal of unenforceable provisions restricting import of fluorescent lamps;
- revision of unfavorable provisions that prevented import of certain grades of U.S. honey;
- technical seminars (ISO 9000, shelf life for perishable products, automotive technology and safety, metrology);
- training programs in the United States and Saudi Arabia; and
- installation of Global Positioning Satellite Receiver.

The government of Saudi Arabia has requested NIST to provide U.S. assistance to SASO in the development and implementation of a Kingdom-wide building codes and standards program. A public/private-sector program has been formulated to secure and organize the resources to complement this activity.

ENERGY-RELATED INVENTIONS PROGRAM RECOMMENDATIONS

NIST recommended three innovative technologies for commercialization to its Department of Energy partner under the Energy-Related Inventions Program during June:

- (1) New Technology for Sulfide Reduction and Increased Oil Production—a microbial-based process for reducing the hydrogen sulfide content in oil and gas wells and for preventing the formation of more hydrogen sulfide.
- (2) Turbo-Z Battery Charging System—a modification to conventional battery charger design so that high current discharge pulses of short duration are imposed on top of the steady, regulated charging current.
- (3) Lattice Block Materials: Three Dimensional, Welded-Fiber, Structural Bias-Ply Textiles—a concept for a new structural material and its manufacture.

NIST STANDARD SPHERICAL DIPOLE RADIATOR COMMERCIALIZED WITH NIST HELP

NIST recently provided technical support to a private company in order to commercialize its standard spherical dipole radiator.

As a well-characterized source of electromagnetic fields, the standard radiator provides means needed by members of the electromagnetic compatibility/interfer-

ence (EMC/I) industry for the comparative evaluation of their emissions testing facilities, as well as for fine-tuning them. More such facilities are being built in response to growing societal concerns for the effects of EMI and the need to meet government and regional requirements. A major U.S. manufacturer of electronic instruments with international branches is already using the private company's product in an intercomparison of site-to-site variations in open-area test sites (also known as ground screen ranges) worldwide. As part of the technology transfer effort, NIST staff suggested improvements to the production radiator and performed measurements to validate the performance of production devices. Earlier, NIST demonstrated the value of the radiator for supporting laboratory accreditation measurements. The radiator covers the range 10 MHz to 1000 MHz and has an amplitude dynamic range of more than 40 dB.

LARGE SNS JUNCTION ARRAYS DEMONSTRATED FOR PROGRAMMABLE VOLTAGE STANDARD DEVELOPMENT

Researchers at NIST have advanced the PdAu-barrier superconductor-normal-superconductor (SNS) junction technology for application in programmable voltage standards by demonstrating large arrays of junctions with constant voltage steps. Programmable voltage standards are useful in themselves but, perhaps more importantly, offer a path to an ac superconducting voltage standard through digital waveform synthesis. Working arrays of 4096, 2048, and 1024 junctions, and two arrays with 512 junctions all on the same chip have been fabricated and tested. The small size and inherent damping of these junctions allow a programmable voltage standard design with the required resolution and output current. Another accomplishment embodied in these arrays is a coplanar waveguide design that enables uniform microwave power distribution so that each junction has constant voltage steps within the same bias current range. Each array showed constant voltage steps of at least 1 mA amplitude with applied microwave power. When all five arrays were biased in series, the power distribution was sufficiently uniform to achieve milliamperes-wide steps. Near the 10 GHz design frequency, the 8192 junctions produced a constant voltage step at 186.333 mV (corresponding to about 23 mV per junction). At 15.43 GHz, the 8192 junctions generated a step at 267.3 mV.

These results demonstrate for the first time large arrays of SNS junctions with uniform microwave power coupling. With only a factor of four increase in the number of junctions, it should be possible to demonstrate a programmable voltage standard with a range of ± 1 V, 15 bit resolution, and 30 bit accuracy.

NIST VOLTAGE-TUNABLE JOSEPHSON OSCILLATOR SETS NEW POWER RECORD

Extending earlier work, a team of scientists at NIST has designed, fabricated, and tested a phase-locked array of Josephson junctions that has produced a record 0.7 mW at 170 GHz from an array of 2000 junctions, supplied to a load of 52 Ω . This array was voltage tunable and capable of coupling more than 0.1 mW to the load over the frequency range 100 GHz to 300 GHz. Few sources of millimeter-wave power are available to serve as local oscillators for receivers in this range, which is under consideration for commercial applications. For example, the FCC recently announced that it proposes regulations to about 150 GHz. Another important application is earth observation from a satellite. The NIST array constitutes a significant advance for oscillator's applications because the Josephson oscillator dc to ac conversion efficiency is as high as 8 % to a matched load. Other known devices operating in this range are much less efficient.

The array is made possible by a new development in fabrication technology. The shunt resistor associated with each tunnel junction is fabricated as close as possible to the junction by depositing the resistor film underneath the junction trilayer and then configuring the Josephson junctions and resistor to be as wide as possible with respect to the intended oscillator operating frequency (less than one-quarter wavelength).

MEASUREMENTS ON MESOSCOPIC RESISTORS ADVANCE UNDERSTANDING OF LOW-TEMPERATURE NOISE PHENOMENA

Two NIST scientists have made accurate noise measurements on a small thin-film resistor (30 μm long, 3 μm wide, and 40 nm thick) at temperatures from 50 mK to 200 mK and demonstrated noise that approaches $S_I = (0.86)eI$ in the limit of large currents. As electronic circuits are pushed to smaller dimensions and lower temperatures, researchers can expect to observe new physical phenomena. For instance, while classical Johnson noise in macroscopic resistors is independent of current, theorists recently have predicted that mesoscopic resistors at millikelvin temperatures will exhibit shot-like noise, with a power spectral density $S_I = (2/3)eI$ proportional to current. In this theory, the prefactor of 2/3 is derived assuming that both electron-electron and electron-phonon coupling are weak. The scientists have shown that the prefactor of 0.86 results in a regime, not previously considered, where electron-phonon coupling is weak but electron-electron coupling is strong.

In future experiments with yet smaller resistors, the NIST team hopes to enter the regime in which electron-

electron coupling is also weak and verify the predicted prefactor of 2/3. The understanding gained in this study could be fundamental to the design of future ultra-low-noise microcircuits.

NIST FABRICATES "PERFECT" MIRRORS FOR MICROWAVE SPECTROMETER

NIST scientists recently completed single-point diamond turning of the second matched pair of 350 mm radii, 350 mm aperture mirrors for a Fabry-Perot resonant microwave cavity being assembled at NIST. The mirrors are being used in a transportable Fourier transform microwave spectrometer, which was scheduled to be placed in a testbed environment. They will be used as a new method of on-line trace-gas emissions analysis for oxygenated hydrocarbons in automotive exhaust streams.

Antenna insertion losses for commercially procured mirrors used in a previous system were measured to be 10 dB. The measured insertion losses for the first pair of new mirrors are 3 dB—the theoretically predicted value for a perfect mirror. Although the operating wavelengths are long in classical optics terms, the finesse of the cavity is high, placing relatively tight demands on figure and surface finish. NIST researchers have already developed post-polishing processes for diamond turned aspheric optics, which could be applied to further enhance mirror performance if required.

PROBING THE FOUNDATIONS OF PHYSICS—ONE ATOM AT A TIME

The Pauli Exclusion Principle (PEP) is one of the cornerstones of modern physics—without it, the world would be drastically altered. Yet recently, scientists have reexamined its fundamental nature and are questioning whether our theories might be resting on shaky ground. Can there ever be occasions when PEP is not strictly obeyed? Long since forgotten by many, the admonitions of Pauli himself warn about the inadequacy of our fundamental understanding in this area. A persistent question remains: why do most of the states which quantum mechanics predict, never actually show up in experiments?

Part of the answer lies in the existence of a superselection rule, which prevents many PEP-violating states from producing expected observables, even when the states themselves do exist relatively often. This invalidates many apparent high-precision tests of PEP. New theoretical activity has suggested ways in which rare violations of PEP might sneak into very sensitive experiments, and this has stimulated a number of laboratories to deploy modern high-precision techniques to search directly for these effects. If detected, a small-scale violation of PEP would require a radical readjustment of

theoretical physics, comparable to that which occurred when parity-violation was first discovered at NIST 38 years ago.

A test has been carried out at NIST using an ultra-low background laser fluorescence system, which also can detect single atoms and produce sub-natural linewidths using a time-correlated photon-burst technique. The test was notable since it was the first-ever test on a system of fermions for which detailed calculations were available, and it was the first to look systematically for states that violate the symmetrization postulate and imply a violation of PEP but do not directly involve multiple occupancy of any quantum state. The results confirm that if nature is violating PEP, it is doing so only very subtly—and below the few parts-per-million level. The full power of the photon-burst technique could be deployed to further reduce this limit by many orders of magnitude.

NEW METHOD TO POLARIZE NEUTRON BEAMS

Polarized neutrons are very useful for studies of magnetic materials and for investigations of fundamental symmetries in nuclear interactions. However, conventional methods of polarizing neutrons create high gamma-ray backgrounds and are effective only for very low energy neutrons. Researchers at NIST have made significant progress in efforts to develop a “spin filter,” a new device to produce polarized neutrons using laser polarized ^3He . Because neutrons with spins anti-parallel to the ^3He nuclear spin are absorbed 5000 times more strongly than neutrons with their spins parallel to the ^3He , an initially unpolarized neutron beam incident on a sample of highly polarized ^3He will have most of the “wrong” spin state absorbed, while the “right” spin state will be transmitted.

The main obstacle to making a ^3He spin filter is producing a large amount of highly polarized ^3He . Two separate methods are being pursued in parallel to achieve this goal: “metastable optical pumping,” which produces highly polarized gas at a low density (1/1000th of the necessary density), and “spin-exchange optical pumping,” which produces polarized gas at densities appropriate to producing a practical spin filter but has more difficulty achieving high polarizations.

Milestones achieved include completion of the optical pumping and polarization measurement system for the metastable technique, including polarization of 250 cm^3 of ^3He to 75 % (at 0.3 mbar pressure), and calibration of the nuclear magnetic resonance system for measuring polarization in the spin-exchange apparatus (currently 25 % polarization of 100 cm^3 at 1 bar pressure).

Optimizations of both systems will continue with initial neutron beam tests in the fall.

BLUE DIODE LASERS

If diode lasers were crayons, it would be tough to color the sky. Researchers have been working to make microchip-sized diode lasers that emit different colors, with potentially different applications. Blue diode lasers have proved difficult to make. NIST researchers have developed a diode laser system that emits about 40 mW of blue light in the 425 nm region of the spectrum. The system consists of an infrared laser directed through a potassium niobate crystal that doubles the laser’s frequency, creating blue laser light. The researchers are using the system to cool calcium atoms, which may prove to be an even better wavelength reference than existing standards. They also are using the system in laboratory experiments to measure short-lived atmospheric chemicals believed to be important in ozone depletion. The group hopes to make the system smoothly tunable across a range of blue light frequencies.

OBSERVATION OF LASER OSCILLATION WITHOUT POPULATION INVERSION

Until recently, it was believed that a requirement for laser oscillation was a greater population in an excited state than in the ground state, i.e., population inversion. In a recent collaboration with scientists from Texas A&M University and Russia’s Lebedev Institute of Physics, two scientists have demonstrated laser oscillation without population inversion. The experiments at NIST followed the theoretical suggestion that, in a V-type configuration of energy levels, atomic coherence can result in gain without population inversion. The V-type configuration is two excited states and the ground state. A strong driving field on one transition has a significant effect on the critical second transition that shares the same ground state as the driven transition. This was the first demonstration of actual lasing without population inversion.

The experiments were carried out in a rubidium cell using only 25 mW of drive power from simple diode lasers. Measurements clearly indicated that the observed rubidium laser oscillation occurred without population inversion and that it was the presence of the coherent drive-laser radiation that produced the conditions necessary for this oscillation.

The work has possible practical implications. In particular it suggests the possibility that short wavelength lasers (in the ultraviolet region and beyond) might be feasible. While the work described here involved

laser oscillation at a wavelength not too far from the wavelength of the drive laser, there is now the clear possibility that the same approach could be used to produce laser oscillation at much shorter wavelengths, far removed from the wavelength of the drive laser. Experiments to test this possibility are in progress.

IMPROVED PHOTOVOLTAIC FILMS FOR ELECTRICITY PRODUCTION

Inexpensive photovoltaic films of hydrogenated amorphous silicon (a-Si:H) are used for electric generation, but they tend to lose electrical efficiency after a few months in sunlight. Migrating hydrogen within the a-Si:H film seems to be the cause, but the obvious solution of lowering the film's H content led to inferior photovoltaics. Using an improved method of deposition that employs silane decomposition on a hot tungsten wire suspended above a substrate, scientists at NIST and the Department of Energy (DOE) have been able to produce a-Si:H films with low H content and excellent film quality. This new material currently is being integrated into photovoltaic cells. The method utilizes a flow of silicohydride gas past a 1800 K heated filament to decompose the compound to silicon atoms and atomic hydrogen. This is in contrast to the usual industrial method of decomposing the silicohydride with a radio frequency discharge. The NIST and DOE scientists recently have been issued a patent for this process.

SUBLIMATION DYNAMICS FROM MOLECULAR THIN FILMS

Scientists at NIST recently succeeded in looking at quantum state-resolved sublimation dynamics of thin molecular films. Using direct absorption of tunable diode lasers on CO₂ molecules, the NIST scientists probe molecules that have freshly sublimed from the surface. Sufficiently low pressure conditions make it possible to eliminate scrambling of the quantum state distribution which is formed. This direct absorption technique is sensitive enough to probe the sublimation rates of CO₂ and water at below one monolayer per second with Doppler and quantum state resolution. The observed distributions carry information for the reverse process, or the quantum state resolved "sticking" co-efficients of the molecules at the gas-solid interface. Such information on gas-solid sticking coefficients is important to heterogenous chemistry on stratospheric aerosols and molecular ices, with potential relevance to epitaxial growth in the semiconductor industry.

SOLDER INTERCONNECT DESIGN WORKSHOP AT NIST

Scientists and engineers from industry, government, and academia met at NIST recently to establish a collaborative program in solder interconnect design. This effort will develop software modeling tools for improving solder interconnect geometries with the goals of higher manufacturing yields and higher reliability. Such modeling tools are necessitated by the move toward ever-increasing interconnect densities without substantial changes in lead geometries and assembly processes. Assembly soldering processes, which worked extremely well at lower interconnection densities, produce increasing numbers of open circuits and shorts, known as solder "bridges," in the final soldered assemblies as the interconnection density increases. Furthermore, decreasing size scales lead to higher thermomechanical stresses on the joints and can result in higher failure rates in service. The ultimate goal of the program will be to create an integrated design, manufacturing simulation, and reliability modeling tool for designing new packaging that meets the interconnection density needs of the electronics industry. The critical need for such modeling tools has been identified by the Semiconductor Industries Association in its 1992 SIA Technology Roadmap for advanced packaging systems.

This group, known as the "Solder Interconnect Design Team," will use Internet and the World Wide Web to provide simple case studies of solder joint geometries common to many types of components, promote communication among group members, and initiate a dialogue with package designers and other interested groups about the requirements for the design system. Semiannual workshops will be held at NIST. Additional information can be obtained via Internet from <http://www.ctcms.nist.gov/programs>.

ELECTROACOUSTIC CHARACTERIZATION OF CERAMIC POWDER SUSPENSIONS FOR PROCESS CONTROL

On-line measurement and control of processing parameters is necessary for reproducible production of ceramic components. NIST scientists have demonstrated the use of electroacoustic measurement techniques for in-situ determination of particle size distributions and zeta potential in ceramic slurries. This research was conducted in cooperation with an instrument manufacturer and several ceramic companies that are members of the NIST-led Powder Processing Consortia.

A detailed comparative study between the electroacoustic technique and several independent methods was

performed using a model particulate system based on monodispersed silica microspheres. The results of this study showed excellent agreement for both size and zeta potential measurements under a broad range of suspension conditions, and provided insight on the behavior of polymer dispersants. Also, an anomalous electroacoustic effect associated with semiconducting particles was first observed at NIST during studies on silicon, a precursor material for silicon nitride. This “enhanced dielectric effect” has since been confirmed by other laboratories. This observation is critical for future applications of the electroacoustic technique.

NIST HOSTS WORKSHOP ON POLYMER COMPOSITES FOR USE IN THE NEXT GENERATION VEHICLES

A NIST/industry workshop brought together leading experts from automotive manufacturers, materials suppliers, and design software and database companies to discuss the role of data in the introduction of structural composites for the next generation of automobiles. The participants called for NIST to assist in the compilation of composite materials data of a type that would allow parts designers to create parts from these new materials with more confidence.

As with any new material, composites must show a large advantage relative to conventional materials before users will switch to them. Composite parts are currently designed with conservative estimates of materials properties based on typical values. The participants believed highly precise data on well-characterized samples that may not reflect the variations found in high-volume manufacturing would help optimize the design. However, optimization is not the critical step in the introduction of a new material. They felt that the highest priority is for data that provide information on which properties can be reliably obtained in parts commercially fabricated with a given class of materials. For example, a useful database would contain typical data for each material type, values for the ranges of properties that can be expected, and interrelationships between variations in different properties.

The attendees also supported the generally accepted view that the most critical issue hindering the use of composites in automobiles is the lack of rapid and cost-effective manufacturing. Participants explored the role of data in addressing this need as well as dealing with the next set of challenges: design, durability, and integration of manufacturing and design.

DENDRITE GROWTH MODEL FOR AIRCRAFT ENGINE COMPONENTS

NIST scientists are collaborating with manufacturers of aircraft engines and their components in a NIST/indus-

try Consortium on Casting of Aerospace Alloys, which seeks to improve the efficiency and reliability of manufacturing processes. The superalloy blades in modern turbine engines frequently are manufactured in the form of single crystals, with exacting demands on the perfection of the crystal structure. These components are made by a directional solidification process in which a dendritic crystal with a branched or tree-like structure propagates through a mold of complex shape. As part of the consortium’s research program, NIST scientists have developed an analytical model to describe the development of the shape of a dendritic metal crystal as it propagates around corners of such a mold. This model reveals that the local rate of propagation of the dendritic structure is extremely sensitive to the thermal field within the mold. The model reveals how certain thermal conditions can lead to very high local rates of propagation of the dendritic structure, which in turn can lead to the formation of defects. As a result, the part is rejected. The NIST model uses several simplifying assumptions about the thermal field and dendrite growth behavior. It also has been used to verify the accuracy of a numerical technique, which can be applied to a wide range of more complex conditions.

DIGITAL SIGNATURE ALGORITHM APPROVED AS AN INDUSTRY STANDARD

The American National Standards Institute (ANSI) Board of Standards Review recently approved the Digital Signature Algorithm (DSA) as an American National Standard. The DSA was developed by the government to provide a cost-effective method for replacing a handwritten signature with a digital signature. Issued as Federal Information Processing Standard (FIPS) 186 in May 1994, the DSA can be used to identify and authenticate the originator of information, and to verify that information has not been altered after it is signed. NIST’s contributions to technical committee X9F1, Public Key Cryptography for Financial Institutions, played a major role in the adoption of the DSA as an industry standard.

NEW PUBLICATION DESCRIBES THE CENTER FOR HIGH INTEGRITY SOFTWARE SYSTEM ASSURANCE (CHISSA)

NISTIR 5677, Center for High Integrity Software System Assurance-Initial Goals and Activities, highlights the current activities and accomplishments of CHISSA. NIST created the center last fall to establish criteria for software assurance for use by those who build or evaluate critical software systems, which must be trusted to work dependably. With input from industry and academia gained through a call for white papers with 94 respondents, CHISSA developed short- and

long-term goals and plans for activities to address major industry needs. Planned projects, which will disseminate information to help industry to produce high-integrity software systems in a cost-effective manner, include an experimental laboratory to facilitate academic research and industrial interaction, an interactive demonstration facility on the World Wide Web, industry focus area workshops, technology diffusion workshops, topical workshops, and collaboration with funding agencies.

NIST ASSISTS ADVANCED RESEARCH PROJECTS AGENCY (ARPA) IN EVALUATING PERSISTENT OBJECT BASES

NISTIR 5636, Persistent Object Base System Testing and Evaluation, summarizes NIST's role in support of ARPA in the testing and evaluation of persistent object base (POB) systems. The goals of the project were to evaluate various aspects of POB technology, to use evaluation results to assess the applicability of object technology to design problems, and to identify the potential usefulness of object technology in a distributed environment.

The evaluation consisted of designing a testing suite for exercising the POB system for the features supported. Tests were conducted on an ARPA-funded prototype POB system called the Open Object-Oriented Data Base (OODB), which was developed by a private company. The work will facilitate the adoption of the POB technology by industry and standards communities by providing evaluation and testing methodologies for future research.

NEW REPORT FOCUSES ON ENVIRONMENT INTEGRATION REQUIREMENTS

NISTIR 5654, Defining Environment Integration Requirements, describes a process for defining environment integration requirements, especially data and control integration requirements, using the Information Technology Engineering and Measurement (ITEM) model for information technology use in an enterprise. The NIST report discusses the use of enterprise and process modeling to classify the features of the enterprise process, its automation and the external stimuli on the enterprise that affect choices for tool and environment integration. Also given is a detailed example using the ITEM model to define requirements in the software development domain. Improved requirements reduce costs over the entire development life cycle by decreasing

the number of costly errors and miscommunications in later phases of the life cycle.

NIST, AUTO MAKERS TEAM UP FOR LOWER EMISSIONS

A new research program at NIST will help U.S. auto manufacturers develop and test low-emission vehicles. The program, done in cooperation with regulatory agencies, also eventually could help emission testers measure a variety of exhaust gases in a few seconds. Auto makers need new measurement technologies and standards in order to design cars and trucks that will meet increasingly stringent federal Clean Air Act requirements and California emission standards. NIST is collaborating with the American Industry Government Emissions Research organization to meet this need. AIGER is an umbrella group that includes the Environmental Research Consortium, the California Air Resources Board, and the EPA. The new research effort includes an "electronic nose" (an array of micro-sensors, detectors, and a microprocessor on a credit-card-size device), a new primary flow meter calibration facility at NIST, analyzing automobile exhaust analysis using infrared light and microwaves, and gas cylinder standards.

NEW WEB SITE PROFILES ISDN

The North American ISDN Users' Forum (NIUF), sponsored by NIST, has launched a World Wide Web site to allow easy access to information it generates and gathers. NIUF works to create a strong user voice in the implementation of applications for Integrated Services Digital Network (ISDN) which allows users to exchange voice, data, and image information concurrently over telephone lines. The web site features detailed information about the group's organization, membership, accomplishments, and future directions. There are links to various NIUF working groups that contain group charters, meeting minutes and documents. Other regional user groups and ISDN home pages are linked to the NIUF site, and many of the applications developed in the NIUF are available. The site can be reached at <http://www.niuf.nist.gov/misc/niuf.html> by anyone with a properly equipped computer running WWW software, such as Mosaic or Netscape. Public access to Internet resources is available at a growing number of public libraries, schools, and other organizations across the country. For assistance when accessing the home page, contact Sara Caswell by phone at (301) 975-2937 or e-mail at niuf@nist.gov (via Internet).

GROUP EXAMINES OPTICAL TAPE DATA STORAGE STANDARDS

Preserving the integrity of electronically stored data becomes increasingly significant as the amount of information processed by computer systems proliferates. Heeding industry's call for data integrity and standards for emerging optical tape media, devices and applications, researchers at NIST are participating in the Optical Tape Study Group established by the Association for Informational and Image Management International. This is one example of NIST's collaboration with industry and government organizations in developing measurements, evaluation techniques and standards for long-term computer data storage. The recently established study group explores such issues as the data integrity of optical tapes, metrology concerns, media and drive specifications, and possible future standards. Several key organizations in the data storage industry participate in the study group. For more information about the Optical Tape Study Group, contact Fernando Podio, by phone at (301) 975-2947 or e-mail: fernando@pegasus.ncsl.nist.gov (via Internet).

NEW MICROLITHOGRAPHY METHOD MAY HELP SHRINK CHIPS

A new form of microlithography that uses neutral atoms instead of light to write patterns on silicon has been demonstrated by scientists from NIST and Harvard University. The new method offers the future promise of manufacturing integrated circuits or other microfabricated objects about 1/10th the size that is currently possible with light-based lithography methods. The scientists' results are reported in the Sept. 1, 1995 issue of the journal *Science*. The experiments involved directing a beam of metastable argon atoms through a copper grid or screen with holes about 10 μm across. The atoms were used to write patterns on a gold surface covered with a photosensitive layer called a resist. In the new microlithography method, the resist is a self-assembled monolayer made of organic molecules known as alkanethiolates. Wherever the metastable atoms hit this experimental resist, they release their energy and break hydrocarbon bonds. Areas of gold underneath the weakened and damaged bonds then are washed away with a chemical bath. The result is a grid of gold lines a few micrometers wide, which then can be chemically transferred into the silicon.

LASER LENS DRAWS NANODOTS ON SILICON

Physicists at the National Institute of Standards and Technology like to think small. Their newest creation—

an array of metallic nanodots—is among the smallest fabricated objects on earth. Each nanodot is about 80 nm wide. That's about one one-thousandth of the diameter of a human hair. Scientists say the technology used to make the nanodots could be adapted to draw more complex patterns for integrated circuits on silicon chips. Once developed, such a method might provide a way to pattern circuits with linewidths as small as 1/10th the width of those in current computer chips. To make the chromium nanodots, a group of NIST physicists modified a technique they devised 2 years ago to draw rows of nanolines on silicon. In that first experiment, they used a laser wave to guide chromium atoms to the surface in rows spaced 213 nm apart, exactly half the length of the laser wave. Two perpendicular laser waves focused chromium atoms into evenly spaced dots in the most recent experiments. Since the distance between the dots is determined by the laser wavelength, which is known with very high accuracy, the nanodot arrays also could serve as an atomic ruler for instruments such as atomic-force microscopes. For more information, contact Jabez McClelland, B206 Metrology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3721, e-mail: jabez@epg.nist.gov.

MANUFACTURER GETS REMINERALIZATION LICENSE

A major breakthrough in oral health care has moved closer to the marketplace by the licensing of several tooth remineralization and desensitization applications from the American Dental Association Health Foundation to a leading international manufacturer of health care products. The technology was invented by an ADAHF research associate in the Paffenbarger Research Center at NIST. The license gives the manufacturer the rights to develop and market products based on amorphous calcium phosphate compounds patented by ADAHF. These compounds make teeth less sensitive to hot, cold, air pressure and touch, and increase tooth resistance to dental caries. These compounds may be applied topically by dental professionals and individuals. The manufacturer will have exclusive license in the United States for the process in products for several oral care applications but will share foreign co-exclusive rights with another private company for mouthwash and professional gels. The second company holds exclusive rights worldwide for the process in toothpaste, chewing gum, food and candy. For information, contact the ADAHF, A153 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6809, fax: (301) 963-9143.

NEUTRON FOCUSING LENS HONORED WITH R&D 100 AWARD

On Sept. 19, 1995, Research and Development Magazine recognized a neutron focusing lens developed by NIST and two New York State partners, an optics company and a research university, as “one of the 100 most technologically significant new products of the year.” The optics company received funding from the NIST Advanced Technology Program to develop the device. The company also worked with researchers at the NIST Cold Neutron Research Facility and The State University of New York at Albany to characterize and improve the lens. The lens dramatically improves two analytical techniques—neutron depth profiling and prompt gamma activation analysis—which use neutrons to measure the distribution of elements in various materials. Future applications of the lens may find it used for x-ray focusing, other neutron-based research methods, and medical diagnostic and therapeutic treatments. The lens is made of 1763 glass capillary fibers. These thin hollow hexagonal fibers each contain 1657 capillary channels that are 9 μm in diameter (about one-tenth the diameter of a human hair). The lens, therefore, contains 2.9 million tiny channels for directing and focusing neutrons to a 0.5 mm spot.

NIST, PARTNERS PROVIDE MATH AID TO DESIGNERS

NIST’s new Center for Theoretical and Computational Materials Science is collaborating with the National Science Foundation to apply both Green’s Functions and boundary element analysis to materials problems in industry. These are related mathematical techniques used to model the mechanical behavior of advanced materials. Other participants in the collaboration include industry, academia, and government agencies. Green’s Function analysis is particularly powerful when applied to stress analysis of advanced materials since the material’s microstructure can be incorporated directly into the model. One company is interested in applying the analysis to predict the performance of composite materials, such as those found in automotive fan belts. Another project will explore the development of a electronic library from which design engineers could access Green’s Function data. For more information about the consortium, contact Vinod Tewary, Materials Reliability Division, NIST, Boulder, CO 80303-3328, (303) 497-5753, or e-mail: tewary@boulder.nist.gov.

UNITED STATES, CANADA MUTUALLY RECOGNIZE TESTING LABS

In an effort to improve trade between the world’s two largest trading partners, NIST and the Canadian General

Standards Board (CGSB) recently signed an agreement for the mutual recognition of testing laboratories administered by the NIST National Voluntary Laboratory Accreditation Program (NVLAP) and the Laboratory Acceptance Program operated by CGSB. The mutual recognition agreement provides for mutual recognition of testing laboratories located within the territorial United States accredited by NVLAP and for testing laboratories within Canada that are accredited by CGSB’s Laboratory Acceptance Program. Both programs meet the requirements of international standards for accrediting labs under ISO/IEC Guides 25 and 58. The CGSB program was established in 1979 and is one of six national certification organizations accredited by the Standards Council of Canada. Established in 1976, the NIST NVLAP program currently has more than 850 accredited laboratories. For more information, contact NVLAP, A162 Building 411, NIST, Gaithersburg, MD 20899-0001, (301) 975-4016, fax: (301) 926-2884.

COMPREHENSIVE GUIDE TO TIME AND FREQUENCY DATA ISSUED

A bibliography of NIST publications in the field of time and frequency is now available. It covers the modern era of this technology; that is, papers dating from the introduction of atomic clocks. Every paper published by NIST in this field since 1967 is included, plus selected papers on atomic clocks dating back to the early 1950s. The papers have been grouped into 23 categories, including broadcast services, calibration methods, frequency synthesis, ion storage research, lasers, measurement methods and time scales, to name a few. Also provided is a section listing books, journals, special issues of journals and conference proceedings in this field. More general papers on tutorials and general time and frequency are found in separate sections. Time and Frequency: Bibliography of NIST Publications (NISTIR 5035) is available for \$27 prepaid from the National Technical Information Service, Springfield, VA 22161, (703) 487-4650. Order by PB 95-220463.

Standard Reference Materials

SRM 1643d—TRACE ELEMENTS IN WATER

Maximum permissible levels for a number of inorganic elements in drinking water and ground water are set by the Safe Drinking Water Act and the Clean Water Act, together with regulations issued by the Environmental Protection Agency. Numerous water quality laboratories

across the United States test water quality to monitor compliance with these laws and regulations.

Since 1977, the NIST Standard Reference Materials Program has been issuing Standard Reference Material SRM 1643, Trace Elements in Water, and its renewal issues, to calibrate equipment used to test compliance with this act. This SRM is the second highest selling SRM of over 1300 SRMs stocked.

The latest issue, SRM 1643d, was prepared in cooperation with the U.S. Geological Survey, Water Resources Division, and simulates the elemental composition of fresh water. It is a sterilized, filtered and acidified water, containing no natural bacteria or anions, and spiked with 26 elements whose certified concentrations approach the regulatory limits. As part of the certification program, 60 water quality laboratories participated in a round robin exercise analyzing the SRM. The laboratories obtained highly consistent results. Elements included in the certification of the SRM are: lead, arsenic, antimony, cadmium, chromium, copper, nickel, selenium, thallium, barium, beryllium, aluminum, boron, cobalt, iron, lithium, manganese, molybdenum, silver, strontium, vanadium, and zinc, the first 11 being those regulated in the Safe Drinking Water Act.

SRM 2567—LUBRICANT OXIDATION CATALYST

Crankcase oil performance is vital to the efficiency and longevity of today's combustion engines. Oxidation of oil can lead to a viscosity increase, sludge and lacquer formation, and corrosion. In 1988, the American Society for Testing and Materials (ASTM), published a standard for the ASTM Sequence IIIE Engine Test, a dynamometer test used to measure the high temperature oxidation stability, wear protection, deposits, and oil consumption of engine oils under severe test conditions. This method defines a higher level of performance for the newer oil formulations than the previous Sequence IIID Engine Test and its associated SRM 1817b Catalyst Package.

SRM 2567, Catalyst Package for Lubricant Oxidation, was developed for use in evaluating the oxidation stability of newer lubricating oils. It is used to simulate the chemical environment in an operating engine, specifically under ASTM Sequence IIIE test conditions. The modified thin-film oxygen uptake test (MTFOUT) was used to certify the oxidation induction times of the new oil formulations.

SRM 2567 was formulated to eliminate potential antagonistic effects between the nitro-compounds and amine antioxidants used in previous lubricants. The SRM consists of a set of five 2 mL ampules containing: an oxidized/nitrated fuel fraction, a nitro-paraffin model

compound, a nitro-aromatic model compound, a metal naphthenate mixture, and distilled water.

Standard Reference Data

IN PRINT AND ON-LINE 1995-1996 SRDP PRODUCTS CATALOG AVAILABLE

NIST Standard Reference Data Products Catalog, 1995-96 Edition (Special Publication 782), contains the latest information on nearly 100 computerized databases and published data compilations available from the NIST Standard Reference Data Program and other sources. For more than 32 years, the Standard Reference Data Program has been providing reliable, well-documented data to scientists and engineers for problem-solving and research and development. The data is used to improve the design efficiency of chemical processes, identify potential toxic substances, improve materials durability, and calculate the performance of chemical reactors. Data compilations are available in the following areas: analytical chemistry, atomic and molecular physics, biotechnology, chemical and crystal structure, chemical kinetics, industrial fluids and chemical engineering, materials properties, surface data, thermodynamics and thermochemistry, and special databases of binary images and structured forms. To obtain a copy of SP 782, 1995-96 edition, send a self-addressed mailing label to SRDP, A320 Physics Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-2208, (301) 926-0416, or e-mail: srdp@enh.nist.gov (via Internet).

The new NIST Standard Reference Data Products Catalog (SP 782) is also available on-line through the World Wide Web by using a browser such as Mosaic or Netscape. It can be accessed through the NIST home page (<http://www.nist.gov>) via Measurement Services, or directly at (<http://www.srd.nist.gov>: 8231/). The on-line resource contains information on all currently available SRD databases. Information is provided on data content, search parameters, display features and system requirements of SRD's computerized databases. Price and ordering information is included for all products. The on-line catalog will be updated whenever new or revised products are available. For information, call (301) 975-2208 or send an e-mail message to srdp@enh.nist.gov (via Internet).

Calendar

November 28–30, 1995

FOURTH ANNUAL MEETING OF THE COUNCIL ON IONIZING RADIATION MEASUREMENTS AND STANDARDS (CIRMS)

Location: National Institute of
Standards and Technology
Gaithersburg, MD

Purpose: To provide a public forum for discussion of issues relating to ionizing radiation measurements and standards.

Topics: Advanced techniques in radiation dosimetry and radionuclide analysis for medical, occupational, environmental, and industrial users of radiation and radioactivity.

Format: Subcommittee meetings, plenary sessions, and poster sessions.

Audience: Calibration laboratories, instrument and service suppliers, national laboratories, and government agencies.

Sponsors: Council on Ionizing Radiation Measurements and Standards and NIST.

Contact: Bert Coursey, C229 Radiation Physics Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-5584.

November 29–30, 1995

INCIDENT RESPONSE CAPABILITY COURSE

Location: National Institute of
Standards and Technology
Gaithersburg, MD

Purpose: To provide a training session to both government and private industry on how to create an incident handling capability.

Topics: The seminar will address many of the technical and administrative issues involved in establishing an incident handling capability. Some of the topics to be covered are: organizational goals, incident handling

methods, reporting and issuing alerts, staffing, communications, reporting structure, and Internet security.

Format: Both days will consist of lectures and group discussions.

Audience: The course is designed for security, systems, and network specialists responsible for managing and ensuring the availability and integrity of information technology systems.

Sponsors: NIST.

Contact: Marianne Swanson, A216 Technology Building, NIST, Gaithersburg, MD 20899-0001. (301) 975-3293, email: swanson@csmes.ncsl.nist.gov

December 4, 1995

CONNECTING TO THE INTERNET SECURELY

Location: National Institute of
Standards and Technology
Gaithersburg, MD

Purpose: To provide advice and assistance on many of the technical issues involved in securely connecting to and managing systems and sites that are part of the Internet.

Topics: Securing the system, current threats on the Internet, how to work with incident response teams, and how to obtain sources for more information. Administrative information also will be given.

Format: This one-day course will consist of lecture and group discussion.

Audience: This course is designed for the technical specialist responsible for system/network administration of U.S. government systems. While there are differences between federal and private-sector computing, this seminar will benefit any organization interested in securing their system or site that is connected to the Internet. Some knowledge of the UNIX operating system and system administration practices is required.

Sponsors: NIST.

Contact: Marianne Swanson, A216 Technology Building, NIST, Gaithersburg, MD 20899-0001. (301) 975-3293, email: swanson@csmes.ncsl.nist.gov

January 10, 1996

**USABILITY ENGINEERING:
INDUSTRY-GOVERNMENT COLLABORATION
FOR SYSTEM EFFECTIVENESS AND
EFFICIENCY**

Location: National Institute of
Standards and Technology
Gaithersburg, MD

Purpose: To bring together industry and government to exchange information and strategies for achieving effectiveness, efficiency, and satisfaction in computer-based government systems.

Topics: Usability engineering introduction, usability trends in government, success stories, costs and benefits, standards and guidelines industry strategies and practices, special issues for complex systems, making usability work in the organization.

Format: Plenary sessions, short presentations, and open forum.

Audience: Project development managers, government contractors, procurement officials, analysis and engineers, technical staff and researchers, COTS product vendors, consultants, and policy makers.

Sponsors: NIST.

Contact: Laura Downey, A216 Technology Building,
NIST, Gaithersburg, MD 20899-0001, (301) 975-
4659, e-mail: downey@pegasus.ncsl.nist.gov

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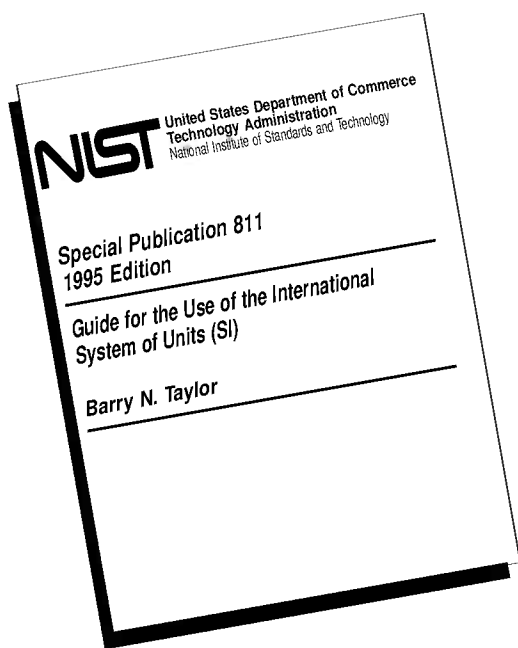
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The International System of Units (SI)

The Modern Metric System



Uncertain about the International System of Units (universally abbreviated SI), the modern metric system used throughout the world? Do you need to know the proper way to express the results of measurements and the values of quantities in units of the SI? Do you need to know the NIST policy on the use of the SI? Then you need the 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*.

The 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*, by Barry N. Taylor, is now available.

The 1995 edition of SP 811 corrects a number of misprints in the 1991 edition, incorporates a significant amount of additional material intended to answer frequently asked questions concerning the SI and SI usage, and updates the bibliography. The added material includes a check list for reviewing the consistency of written documents with the SI. Some changes in format have also been made in an attempt to improve the ease of use of SP 811.

The topics covered by SP 811 include:

- NIST policy on the use of the SI in NIST publications.
- Classes of SI units, those SI derived units that have special names and symbols, and the SI prefixes that are used to form decimal multiples and submultiples of SI units.
- Those units outside the SI that may be used with the SI and those that may not.
- Rules and style conventions for printing and using quantity symbols, unit symbols, and prefix symbols, and for spelling unit names.
- Rules and style conventions for expressing the results of measurements and the values of quantities.
- Definitions of the SI base units.
- Conversion factors for converting values of quantities expressed in units that are mainly unacceptable for use with the SI to values expressed mainly in units of the SI.
- Rounding numbers and rounding converted numerical values of quantities.

Single copies of the 84-page SP 811 may be obtained from the NIST Calibration Program, Building 820, Room 232, Gaithersburg, MD 20899-0001, telephone: 301-975-2002, fax: 301-948-3825.

NIST Technical Publications

Periodical

Journal of Research of the National Institute of Standards and Technology—Reports NIST research and development in those disciplines of the physical and engineering sciences in which the Institute is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Institute's technical and scientific programs. Issued six times a year.

Nonperiodicals

Monographs—Major contributions to the technical literature on various subjects related to the Institute's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NIST, NIST annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NIST under the authority of the National Standard Data Act (Public Law 90-396). NOTE: The Journal of Physical and Chemical Reference Data (JPCRD) is published bimonthly for NIST by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements are available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

Building Science Series—Disseminates technical information developed at the Institute on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NIST under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NIST administers this program in support of the efforts of private-sector standardizing organizations.

Order the following NIST publications—FIPS and NISTIRs—from the National Technical Information Service, Springfield, VA 22161.

Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NIST pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NIST Interagency Reports (NISTIR)—A special series of interim or final reports on work performed by NIST for outside sponsors (both government and nongovernment). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service, Springfield, VA 22161, in paper copy or microfiche form.

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